DEUTSCHES REICH

AUSGEGEBEN AM 16. OKTOBER 1942

REICHSPATENTAMT

PATENTSCHRIFT

№ 726599

KLASSE 31c GRUPPE 24 01

H 164298 VIa/31c

Albert Sälzer in Geisweid, Kr. Siegen,

ist als Erfinder genannt worden.

Hundt & Weber G. m. b. H. in Geisweid, Kr. Siegen

Verfahren zum Umgießen rohrartiger Körper

Patentiert im Deutschen Reich vom 17. Januar 1941 an

Patenterteilung bekanntgemacht am 10. September 1942

Das Umgießen rohrartiger Körper mit Metall von demselben oder höherem Schmelzpunkt bietet erhebliche Schwierigkeiten. Bei einem verhältnismäßig kalten Gießen besteht die Gefahr, daß das Rohr mit dem eingegossenen Metall nicht verschweißt. Infolgedessen entsteht zwischen dem Rohr und dem Umgußmetall ein sehr großer Wärmeübergangswiderstand. Erhöht man aber die Gießtemperatur des Umgußmetalls, so ist, selbst bei Verwendung dickwandiger Rohre, ein stellenweises Auflösen und Durchschmelzen des Rohres oder zumindest ein Eindrücken kaum zu vermeiden. Die derart hergestellten Verbundgußkörper werden daher ebenfalls unbrauchbar.

Zur Vermeidung dieser Übelstände ist vorgeschlagen worden, den einzugießenden Rohrkörper mit Massen zu umgeben, die ihn vor zu starkem Wärmeangriff durch das flüssige Metall schützen sollen. Diese Ausführung ist wohl möglich. Eine unmittelbare Verbindung von Umgußmetall und Rohr wird jedoch verhindert, der Wärmeübergang stark beeinträchtigt, und der eingegossene Rohrkörper kann die bezweckte Kühlwirkung nicht oder nur ganz unzureichend bewirken. Zur Behebung dieser Schwierigkeiten sollen nach einem anderen Vorschlag gerade Rohre von verhältnismäßig großer Lichtweite und hoher Wandstärke während des Umgießens mit Metall mit flüssigen oder gasförmigen Mitteln beschickt werden, um eine allzu starke Erwärmung zu vermeiden und ein Durchschmelzen zu verhüten. Dabei werden aber die Flüssigkeiten oder Gase ohne merklichen Druck an dem einen Rohrende eingeführt und fließen ohne Gegendruck wieder ab.

Bei Erhitzung des einzugießenden Rohres bis nahezu auf den Schmelzpunkt wird der Verformungswiderstand außerordentlich gering. Infolgedessen wird das Rohr an den

✱ Albert Sälzer in Geisweid, Kreis Siegen, ✱
has been named as the inventor

Hundt & Weber G.m.b.H. in Geisweid, Kreis Siegen
Process for encasing tubular bodies

Patented in the German Reich
from 17th January 1941
Patent grant notified on 10th September 1943

The encasement of tubular bodies with metal of the same or higher melting point presents considerable difficulties. In a relatively cold casting, the danger exists that the tube does not fuse to the cast-in metal. Consequently, a very large heat-transmission resistance is created between the tube and the casting metal. If, however, the casting temperature of the casting metal is increased, then, even if thick-walled tubes are used, the tube can scarcely be prevented from dissolving and melting in places, or at least from being compressed. Hence, the composite castings which are produced in this way likewise become unusable.

In order to prevent these drawbacks, it has been proposed to surround the tubular body that is to be cast-in with compounds which are intended to protect it from over-intense thermal attack by the liquid metal. This realization is undoubtedly possible. However, a direct connection of casting metal and tube is prevented, the heat transmission is severely impaired, and the cast-in tubular body cannot, or can only quite inadequately produce the sought-after cooling effect. In order to overcome these difficulties, according to another proposal tubes of relatively large internal

diameter and high wall thickness are fed with liquid or gaseous media as they are encased in metal, in order to prevent over-warming and guard against melting. In this case, however, the liquids or gases are introduced without noticeable pressure at the one tube end and flow off again without counterpressure.

When the tube which is to be cast-in is heated to close to melting point, the deformation resistance is extremely low. Consequently, the tube is compressed at those points which are burdened with a somewhat higher metal column. These difficulties cannot be overcome where there is a free through-flow of liquids or gases.

For the complete elimination of these difficulties, it is now proposed according to the present invention, where tubular bodies, particularly those which are multicurved or have a very small internal diameter, are encased with metal of the same or higher melting point, to pass through the tubes, during the casting, gases or liquids under an adjustable counterpressure, the magnitude of which roughly corresponds to the deformation resistance of the tube at the softening temperature.

Fig. 1 represents in longitudinal section a casting plant for encasing tubular bodies under the passage of gases or liquids during the casting.

Fig. 2 shows the body with cast-in tubular hose, in cross section.

Fig. 3 shows the plant according to fig. 1, yet in top view or in cross section to illustrate the shape of the cast-in tube.

As gas or liquid is fed through with an adjustable counterpressure, in the tube *a* (fig. 1) an internal counterpressure is generated, which maintains equilibrium with the external pressure of the liquid metal *b* and thereby prevents deformation or even breakage and corrosion. In order, moreover, that the medium *c* flowing through the tube abstracts a sufficient quantity of heat from the tube *a* and prevents melting, the flow velocity of the flow medium

must be matched to the casting speed such that the deformation resistance of the tube *a* is not exceeded at the softening temperature. To this end, the casting speed is adjusted such that the pressure which can be read off from a pressure gauge *d* at the inlet end of the tube *a* does not exceed the deformation resistance of the tube *a*. If the measuring instrument *d* indicates a rise in pressure, then the casting speed is slowed down until the state of equilibrium is restored. Too high a casting speed leads to a stronger temperature increase in the liquid or gaseous medium *c* flowing through the tube *a*, which is immediately manifested in an increase in flow velocity and pressure.

In many practical cases, in order to prevent an unnecessarily high consumption of coolants, the flow velocity can be chosen sufficiently low that the boiling point of a liquid flowing through the tube is reached and partial evaporation sets in. This procedure, too, can be applied absolutely safely, provided merely that the pressure and flow velocity in the interior of the tube are kept at constant value. Difficulties can only arise when the inflow velocity drops or falls away "completely". In this case, namely, a sufficient liquid quantity is not available for the evaporation, the cooling of the steam per se, owing to its low thermal capacity and lower thermal conductivity, is no longer sufficient and the result is a compression and rupturing of the tube *a* and an explosive build-up of steam from the liquid still present in the tube *a*.

In order to eliminate such possibilities also, according to a further proposal of the invention the tube *a* is fed from a gas or liquid accumulator *e* which is under constant excess pressure, so that the inflow of the flow medium under constant pressure is guaranteed under all circumstances. Moreover, at the inlet there is advantageously fitted a safety valve *f*, which, when the set pressure is exceeded, automatically restricts the inflow of the flow medium, so that the

set pressure continues to be maintained from the start to the end of the casting, under all circumstances. The flow of the medium under constant pressure must be continued until the completion of the casting, even once the last residues of metal have been poured into the mold.

For the implementation of the process according to the invention, it is therefore vital that, as a result of the through-flowing medium, sufficient additional resistance to the pressure of the liquid metal is lent to the tube, and it also vital to abstract from the tube a sufficiently large quantity of heat per unit of time to preclude the possibility of melting. Both conditions must definitely be met under all circumstances. The case will arise that, in order to obtain a sufficiently large heat abstraction, such a high flow velocity of the through-flowing medium has to be engendered that the pressure which is necessary for this substantially exceeds the deformation resistance of the tube at its softening temperature. The result would be a bursting of the tube due to high internal pressure. Although a reduction in pressure would eliminate this danger, the heat abstraction, on the other hand, would become too small and the tube would consequently melt. Such cases can arise when casting-in tubes of particularly large length and small cross section, which offer greater resistance to the through-flowing liquid. In order to eliminate such possibilities also, and, at the same time, also become broadly independent of the casting speed, according to a further proposal of the invention the coolant used to cool and maintain a sufficiently high internal pressure is abstracted from the tube by a pump *g*, by the use of suction. Here, the pressure prevailing in the gas or liquid accumulator is converted into flow velocity. Any chosen flow velocity can thereby be obtained, given a suitable rating of the pump *g*. By converting the pressure into velocity, it is possible that the deformation resistance of the tube *a*, at its softening

temperature, is not exceeded under any circumstances and the process becomes largely also independent of the casting speed.

In order to have control over the flow velocity of the coolant in the tube *a*, when the tube *a* exits the mold *i*, a flow meter *k* is installed, from which the velocity of the medium can be directly read off. At the outlet end of the tube *a*, furthermore, a restrictor device *l* is fitted, by which the flow velocity can be appropriately adjusted.

Through the use of this process, a large number of composite castings, including with extremely intricate, very heavily wound tube inlays, have successfully been produced, which meet all the requirements and offer a reliable guarantee of perfect fusion throughout between the tube and the casting metal.

In this way, shoes permeated with cooling tubes for the electrodes of electric ovens have been created, for example, which were subjected to highest conceivable current loads and nevertheless received a satisfactory cooling through the use of the composite castings produced according to the invention. Such an electrode shoe is represented in similar fashion in figs. 1 to 3 in its outer contours.

PATENT CLAIMS:

1. A process for encasing tubular bodies, in particular bodies which are multicurved or have a small internal diameter, with metal of the same or higher melting point, with gases or liquids being passed through the tube, wherein gas or liquid is passed through the tube under adjustable counterpressure which advantageously approximately counterbalances the deformation resistance of the tube at its softening temperature.

2. The process as claimed in claim 1, wherein the casting speed and flow velocity are matched such that constant pressure and constant velocity of the flow medium are assured from beginning to end of the casting.

3. The process as claimed in claims 1 and 2, wherein the tube is fed with the flow medium from a tank in which the flow medium is stored under excess pressure.

4. The process as claimed in claim 1, wherein the counterpressure and the flow velocity in the interior of the tube is maintained by a safety valve, which, when the set pressure of the inflow velocity of the flow medium is exceeded, automatically restricts the flow.

5. The process as claimed in claims 1 to 4, wherein the through-flowing medium which is used to cool and maintain the necessary internal pressure in the tube is passed through the tube by the use of an underpressure.

<u>1 sheet of drawings hereto</u>

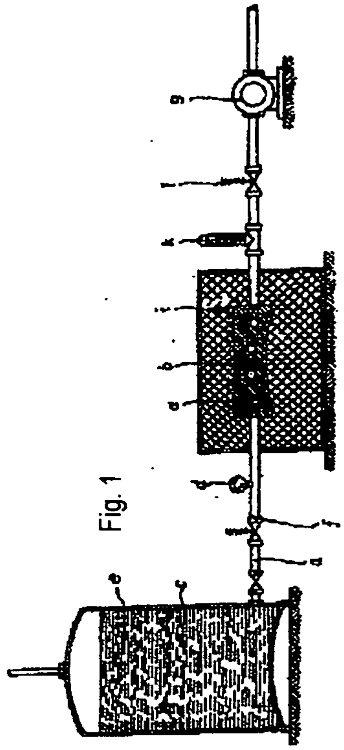


Fig. 1

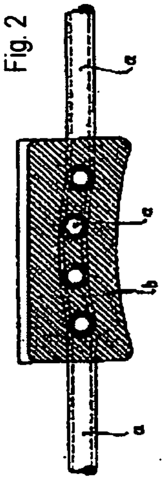


Fig. 2

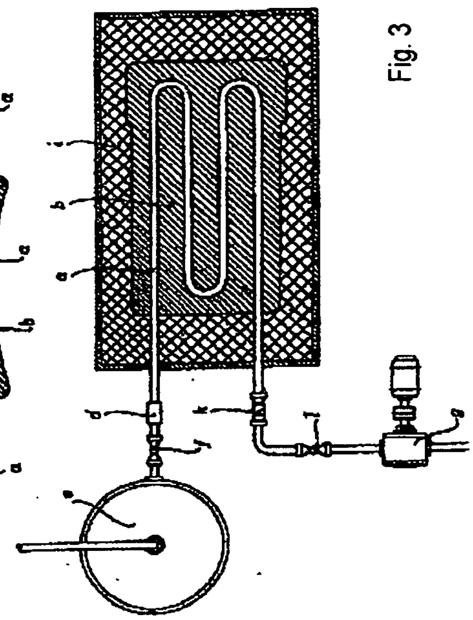


Fig. 3

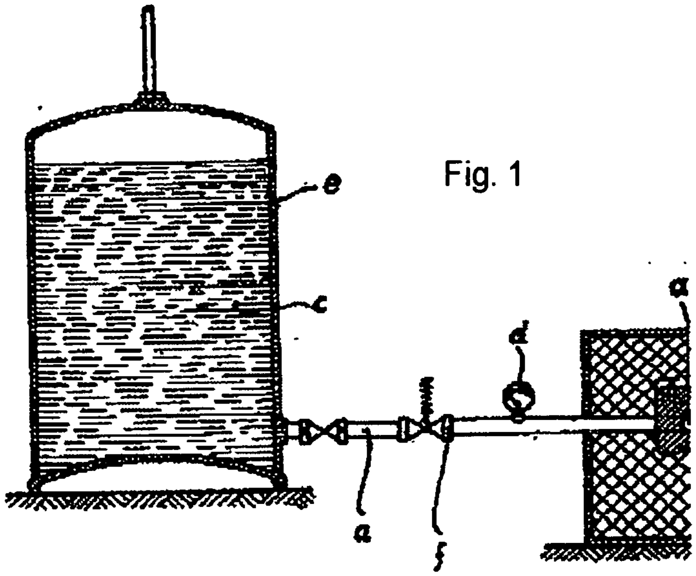
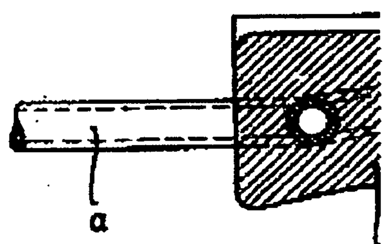
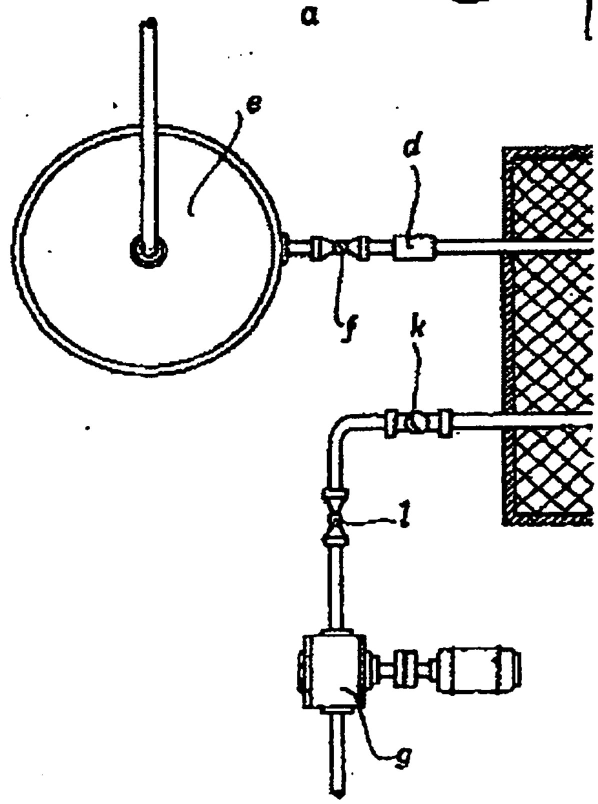


Fig. 1





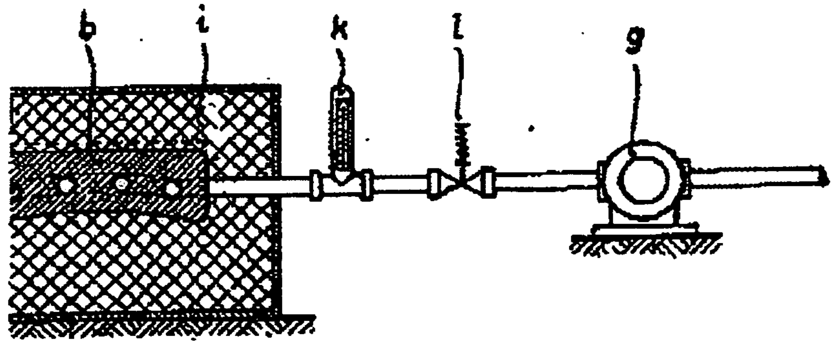
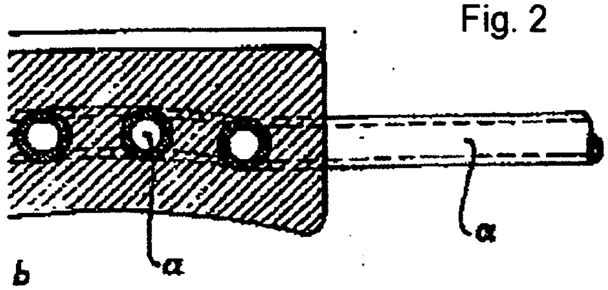


Fig. 2



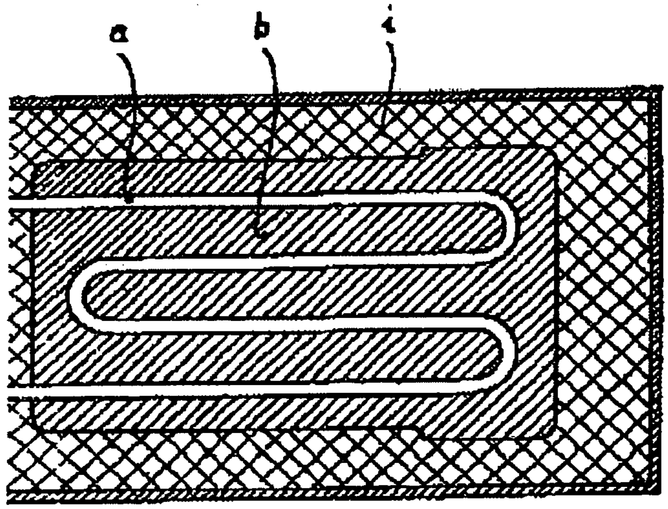


Fig. 3